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THE DEVELOPMENT OF "CERDAS" LEARNING MODEL BASED ON GARDNER'S THEORY OF MULTIPLE INTELLIGENCES IN NATURAL SCIENCE

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Abstract

The purpose of the study was to develop "CERDAS" learning model based on Multiple Intelligences theory. The syntax consists of six stages which are Self mirror, Concept exposure, Formulate curiosity, Concept exposure, Admit talent, and Memory node. The effectiveness of the model seen from the ability to develop students' intelligences, adherence to the model , as well as student outcomes in natural science. The research used R & D design consited of problem identification, design models, design validation, design revisions, limited evaluation and revision of design based on the evaluation results. Validation of the model was conducted by five experts. The design of learning model was tried out in two stages, first stage to test readability of student worksheet and student book, and second stage to test syntax implementation of the model. The second trial was conducted in a limited scale by applying an explanatory design with experimental design One - Group Pretest - Posttest Design at SMPN1 Banjarmasin. Validation sheet, observation sheets, Multiple Intelligence Test developed by Armstrong (2004), as well as achievement test are used as research instruments. The data analysis used qualitative descriptive techniques and t-test. Based on the results of this study was concluded that (1) "CERDAS" model were feasible for use as a model for developing multiple intelligences, improving student process skills and learning outcomes. (2) Implementation of "CERDAS" model develops multiple intelligences, and concept mastery of the students. (3) Students gave very good respon for the model, especially for lab activities , application of process skills and talents Admit syntax.

Keywords : "CERDAS" model, multiple intelligences, learning science

INTRODUCTION

According to Gardner's theory of multiple intelligences, all humans have eight types of intelligence in different capacities . The eight types of intelligences and the combination of them cause differences on individual profile (Gardner, 1993). It is important for teacher to recognize student intelligences, because according to Eisner's research (2004), by knowing students dif ferences, teachers can recognize variation ways of students learning, so as can develop the unique abilities of children. In an individual differences based curriculum, students will be given opportunity to get learning experience matching with their own intelligence.

In fact, in our education system, individual differences have not been considered. Researches about the implementation of multiple intelligences theory conducted in several junior dan high schools in Banjarmasin found that less teachers know about Multiple Intelligence. From these results, it can be concluded that teachers' or school attention toward multiple intelligences development remains low. Most teachers view intelligences such as

musical or kinesthetic as a talent that should be developed through extracurricular activities, not to be integrated in learning activities. They assume IQ as an indicator of student achievement (Winarti, 2012). Whereas, IQ test measure logical mathematics and linguistics intelligences only. According to Goleman (1994), IQ only contributes 20% of the person's success. The rest is determined by other factors, which are actually component of multiple intelligences.

On the other hand, teachers ability to select and develop learning strategies appropriate to the purpose and subject matter remains low (Delfy & Kadarko , 2007). Whereas, based on the findings of Yohanes Surya, the average of math and science grades of Indonesian students are basically very good (Surya, 2010). But, they do not get the right teaching methods. Teaching methods used by teachers are very monotonous. It makes science lessons that is actually so fun becomes boring subject. Based on these findings, Surya (2010) concluded that if we could find the right method and a great teacher, Indonesian children will be incredible.

Application of Multiple Intelligences (MI)theory in classroom activities is considered to be a solution to overcome many problems in education. Research conducted by Gosselin (2006) in four schools in the United States showed that the implementation of MI theory in mathematics improves student achievement. Research conducted by Posciak (2007) also found that by implementing multiple intelligences in classroom activities, all student negative behaviors decreased significantly. Gary Chalmers, one of the school curriculum coordinators states that since using the MI approach, student scores math higher. These studies indicate that attention to the diversity of children's intelligence through the implementation of MI in learning strategy capable to overcome many educational problems.

Based on the background, it is designed a learning model that aims to develop students intelligences by implementing MI theory, which is referred to as CERDAS model. This model consists of six stages, respectively, (1) Self mirror, (2) Concept Exposure, (3) Formulate curiosity, (4) Explore concept, (5) Admit talent, and (6) Memory Node. All activities designed refers to enrichment of the network connections of the brain, which aims to develop some particular kind of intelligence. Based on the background, problems to be examined in this study are: How is the effectiveness of CERDAS learning model based on theory of MI in terms of (1) experts validation (2) the development of students 'multiple intelligences, (3) student achievement in science, and (4) student response to the model.

RESEARCH METHOD

The research was conducted by applying Research and Development design. Research procedure refered to the steps of system approach model by Dick & Carey (2009) by following the principles of learning design by Gagne, Briggs & Wager (1992). Each step consisted of (1) identification of learning program objectives , (2) learning analysis, (3) identifying entry behaviors and students characteristics, (4) formulating performance goals , (5) developing an instrument of learning outcomes , (6) developing learning strategies , (7) developing and selecting instructional materials , (8) designing and implementing formative evaluation , (9) revising learning acicities, (10) implementing the summative evaluation.

In developing learning strategies step, syntax of the model was arranged to be a real syntax. In this step, types of student activities accordance with certain kind of intelligence in each step was designed. Furthermore, the syntax model was translated to be a real by arranging Model Book, Teacher Guidebook, Student Book, Lesson Plans, Student Worksheets, and Assessment Instruments.

Prototype of the model was tested by (1) testing the feasibilty the draft of the model

regarding time allocations, students and teachers activities, and making revision based on the result (2) validating the models (i.e. Model Book, Teacher Guide Book, Student Book, Lesson plan, Student Worksheet, and assessment instrument) by five experts (3) revising the model prototype based on the result of the previous step (4) conducting readibility test of student book and student worksheet on small group consisting seven of the 7 th grade students in SMPN 1 Banjarmasin using One - Group Pretest - Posttest Design. It is called one-to one evaluation (Dick & Carey , 2009). (4) revising the model based on the result of the previous steps. (5) conducting small group evaluation in 7th grade students of SMPN1 Banjarmasin using One-Group Pretest-Posttest Design.

The data was get by using validation sheets, learning implementation observation sheet, student activity observation sheet, Multiple Intelligence Test (MI test) developed by Armstrong (2004) and Santrock (2010), as wall as achievement tests. MI test can be found at Abiator 's Online Assessment at http://www.berghuis.co.nz/abiator/lsi/mi_test.html MI. Collecting the data was conducted by observation, test, and non test techniques. The data were analyzed by percentation, descriptive qualitative, and t –test to examine differences student learning outcomes and multiple intelligences before and after conducting learning.

RESULTS AND DISCUSSION

Validator assessment

Lesson plans, student worksheets, assessment instruments, Model Book, Teacher Guidebook, and Student Book were validated by five experts who are competent. Validators come from State University of Malang, Palangkaraya University, and Lambung Mangkurat University. There were 6 lesson plans, 6 student worksheets, 6 assessment instruments, 1 Model Book, 1 Teacher Guidebook and 1 Student book consisting of three chapters were being validated.

Some suggestions given by validator were (1) the format of lesson plan should be adapted to the 2013 curriculum; (2) the ways of writing elements and compounds should be revised according to IUPAC rules; (3) student activities is slightly revised to be more discoveries; (4) Some procedures in student worksheet should be revised in order to be more simple; (5) Some illustrations in student worksheet should be replaced with other more relevant images; (6) Religious character and cooperative should be added through the implementation of activities in the syntax, for instances when groups formulate questions in Formulate Curiosity step, teacher reminds students to work together, or when talent group make work, they are reminded to discuss, work together, and give thanks to God for the talent given to them. (7) In the model book, the guide of model implementation should be written in a flow chart in order to make teachers understand it easier. (8) Teacher Guidebook should include teacher guidelines for preparating student assignment. (9) In order to make more discovery, the student book should be addedd with mini-lab activities that can be tried at home by students with simple tools and materials .

Firts Trial: Test of Readability of Student Worksheet and Student Book

Readability of student worksheets and student book test was conducted in SMPN 1 Banjarmasn with seven of 7th grade students as the respondents. From the trial was known that in general, student worksheets and student book were interesting and easy to understand. Based on students response, there were only a bit revision of student worksheets and student book. Of

six student worksheets being tested, worksheets 3 and 4 still require more revision compared to others. Whereas, from the trial of students book , it were found that (1) some unclear images in chapter 1 and 2 should be replaced, and (2) some difficult terms in chapter 2 and 3 should be explained.

Second Trial: Syntax Implementation of "CERDAS" Model

The data obtained from the second trial were:

(1) Syntax of CERDAS model can be implemented, but the allocation time should be revised. To manage time effectively, steps that requires much time such as Concept exposure need to be made longer, while Self Mirror step made to be shortened. Self Mirror is not always conducted at the beginning of every lesson. In order not to feel monotonous, teacher can change the activity at this stage. For example, beside telling about themselves, students are asked to assess their own homework or assignment and then express the strength and the weaknessess, or other activities. The point is these activities intend to invite students to learn more about themselves in order to strengthen intrapersonal intelligence.

Contrast to Self mirror step, implementation of Concept exposure stage requires considerable time. It is caused by (i) to many substances that are going to be tested; (ii) training science process skill requires a quite long time, it was required patience and considerable time to train students a set of science process skill. To cope this problem, student worksheets were revised by reducing the number of substances being tested, while the component of proces skill was fix.

(2) Students activities in Formulate curiosity step are not going well. At the beginning, beside formulate questions, student are expected to plan methods to answer the question. It was found that formulating questions is difficult activity for student and so does planning method. Therefore, activities in this step were revised by deleting student activity to plan the method. So that, in the third trial students no need to plan the method, but formulating questions only.

(3) Students feel difficult to understand the meaning of acid or base compound if the lesson started from the acid-base concept. Based on this finding, it is recommended to change the order of the subject matter in the third trial, started from (i) Elements, Compounds , Mixture ; (ii) Acids and Bases, then (iii) Material Properties and Its Change.

(4) Six student worksheets are too much and does not in accordance with the time allocation provided in syllabus. To cope with the problem, student worksheets were combined. Student worksheet about Acid and Base was combined with student worksheet about examination of nature of acidity/alkalinity on food. Furthermore, student worksheet about Elements, and element symbol was combined with Compound and Mixture. While worksheet about properties and material changes was combined with worksheet about chemical reactions.

(5) Most junior high school sudents tend to be reluctant to read worksheet instruction and prefer to ask questions direcly to the teacher. Based on this finding, work procedure was revised to be more simple.

(6) Students response to the model is very good, especially for lab activities, application of process skills and Admit talent step that is very typical for this model. Furthermore, the developed learning model was revised again before being tried on the next step.

The development of Multiple Intelligences

Based on the result of MI tests conducted before and after implementation of CERDAS models, as well as from the class observation, it was obtained the data of students multiple intelligences development presented in Table 1 below.

Tabel 1
The Improvement of Student Multiple Intelligences Score
Before and After Implementation of CERDAS Model

Improvement Scores	The number of student	Percentation
≤ 0	11	33,3
1 -10	16	48,5
11-20	3	9,1
21-30	1	3,0
31-40	0	0,0
41-50	2	6,1
Total	*33*	*100*

Table 1 showed that after learning, multiple intelligences scores of 22 or 66.7% of students increased. The most improvement of students scores were on 1-10 points, and the highest increase in the range of 41-50 points experienced by 2 students.

Although 33.3% of students multiple intelligences scores decreased, in fact, on some certain kind of intelligence their score increased. Analysis the data of students multiple inteligences scores before and after implementation of CERDAS models showed that multiple intelligences scores of some students increased on certain kinds of intelligences. Some students increased on one kind of intelligence only, while others increased in many types of multiple intelligences scores. However, their total score decreased because scores decline occuring in some kind of intelligences were greater than scores increase in other intelligences. The data of students' scores improvement on each type of intelligence can be seen in Figure 1 below.

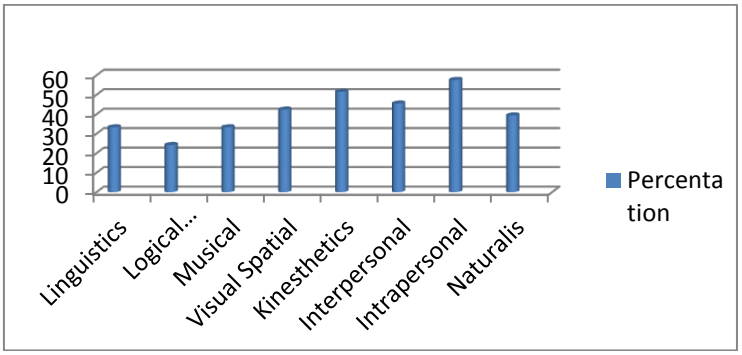

Fig 1.Percentage of Students Whose Scores Had Increased on Certain Kinds of Intelligence

The data indicated that after implementation of CERDAS models, intrapersonal, kinesthetic and

interpersonal were the most increased intelligence. This was presumably due to the implementation of the syntax making students doing a lot of activities to know themselves like in Self mirror stage, or when students were asked to express their understanding about the subject matter through the way they like most on Admit talent stage. Kinesthetic and interpersonal intelligences may have increased due to a greater inclusion of movement and interpersonal relationship in classroom activities, such as playing games, laboratory activities, as well as students activities related to dominant intelligences during Admit talent stage. According to Armstrong (2004), providing opportunity for students to enjoy themselves by let them doing learning activities they like most, formatting team work, playing games, as well as doing hands on activities are believed to exercise and train intrapersonal, interpersonal and kinestetics intelligences. This is relevant to Posciak (2007) who found that after intervention of learning activities that implement multiple intelligences, intrapersonal and kinesthetics are is the most improvement intelligence.

The improvement of the scores on each type of intelligences causes the improvement of dominant intelligences. However, in some specific types of intelligence such as logical-mathematical and linguistic, the improvement of the scores does not significant enough to make both types of intelligence to be a dominant intelligence. In other words, the implementation of the model is able to improve linguistic intelligences score of 11 students and logical mathematical intelligences score of 9 students, but the effect is not signficant. The data about the progress of student dominant intelligences presented in Figure 2 below.

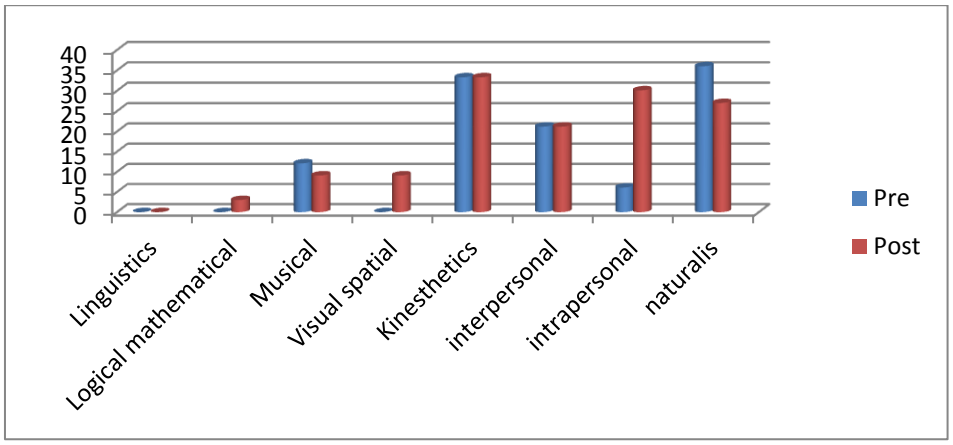

Fig 2. The Improvement of Students Dominant Intelligences

It can be showed from Figure 2 that the percentage of students dominant intelligences changes to be more distributed after implementation the model. Before intervention, the most dominan intelligences were naturalis, but after intervenion of the model were kinesthetics. In addition, before intervention no one has visual spatial intelligences and logical mathematical as the dominan intelligences, but after intervention of the model there were 3 and 1 students who dominant in visual spatal and ogical mathematical. Naturalis is the most dropped intelligences after intervention, while musical is not much decreased. It is similar to Davis (2004) and Posciak (2007) who found that naturalis intelligences dropped in percentage intervention of the model.

The reseach also found that after intervention of CERDAS model, the number of

students who dominant in more than one intelligences increased. Before implementation, it was found that only 6 students who strong in more than one intelligences, but after implementation it is raised to be 11 students. In general, it indicates that implementation of CERDAS model in science classroom is able to increase some kind of multiple intelligences. The most developed intelligence are intrapersonal, kinesthetic and interpersonal intelligences.

The low improvement of students multiple intelligences showed in Table 1, Figure 1 and Figure 2 due to the implementation of the model was conducted in 8 weeks only. If it is conducted in more longer period, the improvement will be greater. Posciak research (2007) showed that the implementation of MI carried out for approximately 14 weeks succed to increase up to 30 % intelligences, but lose naturalist intelligences until less than 12%.

Students Outcomes

Based on assessment test, it was obtained students' outcomes of the subject matter, Acid-base; Elements, compounds and mixtures, as well as Material properties and its changes. Statistical examination by using t-test with SPSS version 18.0 showed that both by using one-way or two-way test, the value of P < t table . In other words, there were significant differences between students' scores on natural science before and after implementation of CERDAS model. Thus, it can be said that implementation of CERDAS model improves students' achievement on all three natural science materials.

Although it was proven statistically that students' achievement on natural science before and after implementation CERDAS models changes, the data of student achievement showed that there were approximately 20.6 % of students who were in lower level. The data of students achievement will be presented in Table 2 below .

Table 2.
The Data of Students Outcomes After Implementation of CERDAS Model

Score	Number of Students	Percentage	Category
< 60	7	20,6	Less
60- 75	18	52,9	Good
76-99	9	26,5	Splendidly/Optimal
100	0	0	Special

The data showed that in terms of mastery of concepts , there were 27 or 79.5 % of students achieved concept mastery, and there were 20.6 % of students failed to obtain mastery of the concept. These score was obtained from the average score of the three subject matter; Acids, Bases; Elements, Compounds and Mixture; Matter and Change. From all subject matter, students obtained high score in Acid Bases, and Elements, Compounds and Mixtures, but get low score in Elements, Compounds and Mixture. That is why, total achievement of the three subject matter were getting lower. It caused by Element Compound and Mixture was the subject mater that seems abstract for 7th grade students of junior high school. If associated with Piaget's Theory of Cognitive Development, 7th grade students (approximately 12 years old) is still in the beginning of the development of formal operational stage. So, it is difficult for them to accept the abstract concept.

According to Piaget (Suyono , 2011) someone learns well if the concept being studied fit with the development of his/her scheme. If it is not, then the individual will find difficulty. To overcome the problem, the subject matter should be made more concrete to be easily understood. These findings means a lot for researchers in revising CERDAS models. The increase of students achievement after intervention of the model is similar with research conducted by Davis (2004) and Kaya, Dogan, and Gokcek (2007). The researches showed that in addition to improving students' multiple intelligences, implementation MI theory can also increase student achievement. This is supported by Gardner (1993) who stated that by using both multiple intelligences theory and learning models together, teachers help students relate to real world experiences. Thus, in additon to increase students' intelligences, students' achievement are going to increase as well.

Nevertheless , the improvement of student achievement is not the main purpose of this model. The development of CERDAS model aims to develop the quality of students thinking skills and intelligence. The improvement of students achievement is resulted by enhancement of students' learning experience. Absolutely, this may not be obtained in a short time. Sato (2013) revealed that in the implementation of innovative learning model, an increase of academic ability is the result that will be attained in the end after another increase.

Student response

The data of student response showed that in general students give positive response to CERDAS model because: (1) through practical activities students are engaged in learning directly ; (2) the existence of group activities encourage students to interact each other , (3) student activities on CERDAS model are enjoyable and in accordance with sudents interest.

From the results it can be concluded that (1) CERDAS model can be contonued to the next trial through small revisions of the syntax, lesson plan, student worksheet as well as the assessment instrument; (2) CERDAS model can be implemented as a learning model by the following supporting data: (1) develop the quality of students' multiple intelligence , (2) improve science process skill of students, (3) slightly increase students achievement, (4) get positive responses from all students .

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

(1) CERDAS model worthy to be used as a learning model to develop multiple intelligences, improve science process skills, and student achievement through syntax Self Mirror, Concept Exposure, Formulate Curiosity , Explore Concept, Admit Talent and Memory Node ;

(2) Implementation of CERDAS model is able to develop multiple intelligences , science process skills, and students achievement;

(3) Students show very good response to CERDAS model , particularly for laboratory activities, application of process skills and Admita talent stage.

Suggestion

(1) It should be conducted a further trial to determine the effect of CERDAS model on a larger sample. (2) In order to implement the syntax well, time allocation have to be planned carefully.

(3) In the next trial, it is required more observer because student activities that have to be observed are going to be complex.

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